F61 - Nuclear Magnetic Resonance 11.03.24

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1. Part I: Relaxicion time

In this part of the experiment we will measure the relaxation time T_1 & T_2 for two samples: GD501, GD600. For that we use different softwares (automat) to perform 10 measurements. The mean and standard deviation will be stored in a txt file.

~~The measurements are then per~~

For the measurement of T_2 we will use two methods: spin-echo and Carr-Purcell sequence. In both case the time between the 90° & 180° τ to sample the free induction decay curve. At every measurement we keep the working frequency $\nu_w \simeq 1\,kHz \pm 50\,kHz$

The final result are written in Tab 1.

Tab 1: relaxtion time T_1 & T_2 for GD samples

	T_{2sp} [ms]	T_{2CP} [ms]	T_1 [ms]
GD 600	104 ± 1	102,8 ± 2,1	159,9 ± 1,3
GD 500	115,8 ± 1,2	116,9 ± 0,9	154,4 ± 1,2

$T_{2CP} = (111,3 \pm 1,5)$ ms
$T_{2sp} = (110,1 \pm 6)$ ms
probably due to the temperature - susceptibility the measurement was wrong.

2. Part II: Chemical shift

In this part we want to use the characteristic chemical shift of substances to identify samples. For every sample we also have a second one with a reference substance, in our case TMS.

To identify the substances we measure the spin echo and perform a fourier transform. In order to ensure a clean measurement we will use a air pump to make the sample rotate, in this way we minimize the inhomogenities of the magnetic field.

(Fourier) We then fit a gaus and measure the position

of the peak. ~~Using the~~ By comparing the measurement of the sample with the reference and without the reference we can identify the peak corresponding to the reference substance. We then measure the difference from the other peaks and reference. Using this data we then ~~use~~ the Fig. 12 of the script to identify the active group:

substance C: $\Delta\nu_1 = 2.2$ ppm ; $\Delta\nu_2 = 11.8$ ppm } C ≙ acetic acid

↳ CH_3 ↳ COOH

substance D

we measure two peaks → $\Delta ppm_1 = 4.1$

and ⇒ fluoroacetonitril $\Delta ppm_2 = 6.5$

substance E: $\Delta pp_1 = 2,3$; $\Delta pp_2 = 7,1$

substance A:

we see three peaks at the Fourier transform without reference, therefore we can immediately recognize it as fluoroacetone.

substance B:

$\Delta pp_1 = 2,25$; $\Delta pp_2 = 7,2$

⇒ we find the same spectrum for substance B & D, however we observe a higher intensity for the first peak, therefore in the spectrum of B

therefore we identify it with p-xylol and

E ≙ tolual.

12.3.24

Part III: Imaging

1. In this experiment we will start by taking a 1-dim profile of three samples. Two of them contains the same oil, but with a higher volumes. We use this two to check the linearity range of our machine.

With these comparison we estimate the linearity range . [-15 mm, 15 m].

Then we insert a third sample which is a teflon immersed in oil. Since teflon does not emit a signal we expect a profile made up of valley where the teflon is and peaks where the oil is.

as expected we observe a square signal with some noise, but fearly constant.

In the other hand the long sample shows a increase in the intensity of the external signals, which shows the deviation from linearity.

(pure collision)
diffusion
$\partial_t C = \Delta \cdot \partial_x^2 C$
≥ 0

2. Secondly we prepare a glas tube with 1.5 cm of sand and the power oil in it. We then proceed to insert it in our imaging device to study the time evolution.

After a while we can observe that the curve of the position is constant, which means that the system is not evolution is not a diffusion process.

3. In the next part of the experiment we will take 2-d profiles of different object.